INVENTORIES OF DELAWARE'S COASTAL VEGETATION AND LAND-USE UTILIZING DIGITAL PROCESSING OF ERTS-1 IMAGERY

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presented at the

Ninth International Symposium on
Remote Sensing of Environment
University of Michigan
Ann Arbor, Michigan

April 15-19, 1974

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SUMMARY

Work carried out over the past two years at the University of Delaware indicated that the coastal zone of Delaware and, in particular, its extensive tidal wetlands offer a unique opportunity to evaluate ERTS-1 sensing capabilities and the feasability of using digital processing techniques to map and inventory coastal vegetation and land-use. Major vegetation species found in the tidal wetlands have been shown to be easily distinquished on the basis of reflectance characteristics in aerial photography[1,2,3] and it was thought that the same characteristics could be used to map the wetlands using ERTS-1 data. Analysis of ERTS color-composite images using analogue processing equipment confirmed that all the major wetlands plant species were distinguishable at ERTS scale.[4] Furthermore, human alterations of the coastal zone were easily recognized since such alterations typically involve removal of vegetative cover resulting in a change of spectral signature.[4] The superior spectral resolution of the CCTs as compared with single band or composite imagery has indeed provided good discrimination through digital analysis of the CCTs with the added advantage of rapid production of thematic maps and data.[5]

Digital Techniques

Computer software, techniques and procedures used to transform ERTS CCT's into the land use maps and data described here were developed in the Bendix Earth Resources Center.

Transforming ERTS CCT's into thematic data is a four step process, performed as follows:

1. Locate Training Areas

In defining the location of the training areas, the CCT containing the areas of interest is screened on the color-coded TV monitor. Utilizing available ground truth, the training areas are identified on a grey scale printout and their locations conveyed to the computer by the investigator.

2. Develop Target Characteristics

Inputting the training area coordinates (boundaries) to the computer permits the ERTS spectral measurements within these boundaries to be extracted (edited) from the CCTs and placed into computer disk files.

3. Evaluate Target Characteristics and Classification Techniques

Once the numerical descriptions which define the spectral characteristics of each land use category of interest are determined a set of canonical coefficients are derived for each land use category of interest.

Before producing decision data on a complete ERTS CCT, a number of tests are applied to evaluate the computer's capability of performing the desired land use classification. One test is to compute and display the canonical variables in the form of "scatter diagrams." These plots aid the investigator in determining the degree of separability being obtained between the target and background categories.

Another test of the canonical coefficients is to develop a classification accuracy table which provides the investigator with a quantitative measure of the classification accuracy achieved by the canonical coefficients in the decision processing. The percentage of each target group which would be classified as another target group is shown thus identifying the areas where signature overlap may introduce errors into the decision processing.

A final test of the canonical coefficient is to view the computer decisions on areas where ground truth is available, thus rapidly determining the effectiveness of the decision processing.

4. Produce Decision Data Products

The decision analysis may be presented in a number of ways, including:

a. The area covered by each category in terms of percent of total area processed, acres and square kilometers.

b. Color-coded decision imagery showing any or all of the categories at any convenient scale.

c. Cal-Comp or Gerber plots of any category, geometrically corrected and plotted at a map scale specified by the investigator.

Results

The primary objective of the analysis was to map and inventory the significant ecological communities of Delaware's coastal zone. To this end, eight vegetation and land use discrimination classes were selected as follows:

1. Phragmites communis (Giant Reed grass)
2. Spartina alterniflora (Salt marsh cord grass)
3. Spartina patens (Salt marsh hay)
4. Shallow water and exposed mud
5. Deep water (2 meters)
6. Forest
7. Agriculture
8. Exposed sand and concrete

Canonical analysis showed that classification accuracy was quite good with Spartina alterniflora, exposed sand - concrete, and forested land - all discriminated with between 94% and 100% accuracy. The shallow water-mud and deep water categories were classified with accuracies of 88% and 93% respectively with all errors in classification occurring as one water category being classed as the other, a condition which is neither surprising nor bothersome with the overlap which these two classes exhibit no matter what the measurement technique used. Phragmites communis showed a classification accuracy of 83% with all confusion occurring with Spartina patens which may be due to use of mixed stands of these species as training sets. Both species occupy similar environments within the coastal zone. Discrimination of Spartina patens was very poor (accuracy = 52%) due, almost certainly, to difficulties in locating large, pure stands of S. patens for use as training sets. Classification accuracy for agriculture was also very poor (51%). Limitations of time and available class-memory space resulted in limiting the analysis of agriculture to very gross identification of a class which actually consists of many, varied signature classes. There is no doubt in the investigators' mind that if crop inventory had been the primary objective of the study, substantially better results could have been achieved in discriminating agricultural land categories.

Abundant ground truth was available in the form of vegetation maps compiled from NASA-RB-57 photography and in the photos themselves - both color and color-IR. Blow ups of portions of the thematic maps digitally derived from ERTS data showed very good correlation with known sites. Cal-comp plots of thematic data at scales up to 1:24,000 showed excellent cartographic precision when overlayed onto existing maps.

It is believed that with further refinement of training set selection, sufficiently accurate results can be obtained for all categories producing a useful planning and management tool.

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